

WHAT IS CLAIMED IS:

1. An optical shifter comprising a first optical shifting section and a second optical shifting section, each of which is able to transmit an incoming light ray after having shifted the optical axis thereof, the first and second optical shifting sections being arranged such that a light ray that has been transmitted through the first optical shifting section enters the second optical shifting section,

wherein each of the first and second optical shifting sections includes:

a liquid crystal element including a liquid crystal cell, the liquid crystal cell selectively changing the polarization direction of the incoming light ray in response to a voltage applied thereto; and

a birefringent element, which receives the light ray that has been transmitted through the liquid crystal element and which exhibits one of multiple different refractive indices according to the polarization direction of the incoming light ray,

wherein the magnitude of shift caused by the first optical shifting section between the optical axes of the incoming and outgoing light rays thereof is substantially twice greater than that of shift caused by the second optical shifting section between the optical axes of the incoming and outgoing light rays thereof.

2. The optical shifter of claim 1, wherein the optic axis of the birefringent element included in the first optical shifting section is parallel to that of the birefringent element included in the second optical shifting section.

3. An optical shifter comprising a first optical shifting section and a second optical shifting section, each of which is able to transmit an incoming light ray after having shifted the optical axis thereof, the first and second optical shifting sections being arranged such that a light ray that has been transmitted through the first optical shifting section enters the second optical shifting section,

wherein each of the first and second optical shifting sections includes:

a liquid crystal element including a first liquid crystal cell and a second liquid crystal cell, each of the first and second liquid crystal cells selectively changing the polarization direction of the incoming light ray in response to a voltage applied thereto; and

a birefringent element, which receives the light ray that has been transmitted through the liquid crystal element and which exhibits one of multiple different refractive indices according to the polarization direction of the incoming light ray,

wherein the magnitude of shift caused by the first

optical shifting section between the optical axes of the incoming and outgoing light rays thereof is substantially equal to that of shift caused by the second optical shifting section between the optical axes of the incoming and outgoing light rays thereof, and

wherein the optic axis of the birefringent element included in the first optical shifting section is parallel to that of the birefringent element included in the second optical shifting section.

4. An optical shifter comprising a first optical shifting section and a second optical shifting section, each of which is able to transmit an incoming light ray after having shifted the optical axis thereof, the first and second optical shifting sections being arranged such that a light ray that has been transmitted through the first optical shifting section enters the second optical shifting section,

wherein each of the first and second optical shifting sections includes:

a liquid crystal element including a first liquid crystal cell and a second liquid crystal cell, each of the first and second liquid crystal cells selectively changing the polarization direction of the incoming light ray in response to a voltage applied thereto; and

a birefringent element, which receives the light ray

that has been transmitted through the liquid crystal element and which exhibits one of multiple different refractive indices according to the polarization direction of the incoming light ray,

wherein the ratio of the magnitude of shift caused by the first optical shifting section between the optical axes of the incoming and outgoing light rays thereof to that of shift caused by the second optical shifting section between the optical axes of the incoming and outgoing light rays thereof is substantially equal to either two to one or one to two,

wherein the optic axis of the birefringent element included in the first optical shifting section and that of the birefringent element included in the second optical shifting section are defined on the same plane but are tilted toward mutually opposite directions from the optical axis of the incoming light ray.

5. The optical shifter of claim 4, wherein the magnitude of shift caused by the first optical shifting section between the optical axes of the incoming and outgoing light rays thereof is substantially twice greater than that of shift caused by the second optical shifting section between the optical axes of the incoming and outgoing light rays thereof.

6. The optical shifter of claim 1, wherein the optical axis of the outgoing light ray of the second optical shifting section is defined by one of first, second and third positions according to a combination of voltages to be applied to the liquid crystal elements of the first and second optical shifting sections, the first position being aligned with the optical axis of the incoming light ray of the first optical shifting section, the second position having been shifted by Δd from the optical axis of the incoming light ray of the first optical shifting section, the third position having been shifted by $2\Delta d$ from the optical axis of the incoming light ray of the first optical shifting section.

7. The optical shifter of claim 3, wherein the optical axis of the outgoing light ray of the second optical shifting section is defined by one of first, second and third positions according to a combination of voltages to be applied to the liquid crystal elements of the first and second optical shifting sections, the first position being aligned with the optical axis of the incoming light ray of the first optical shifting section, the second position having been shifted by Δd from the optical axis of the incoming light ray of the first optical shifting section, the third position having been shifted by $2\Delta d$ from the optical axis of the incoming light ray of the first optical shifting section.

8. The optical shifter of claim 4, wherein the optical axis of the outgoing light ray of the second optical shifting section is defined by one of first, second and third positions according to a combination of voltages to be applied to the liquid crystal elements of the first and second optical shifting sections, the first position being aligned with the optical axis of the incoming light ray of the first optical shifting section, the second position having been shifted by Δd from the optical axis of the incoming light ray of the first optical shifting section, the third position having been shifted by $2\Delta d$ from the optical axis of the incoming light ray of the first optical shifting section.

9. The optical shifter of claim 2, wherein the optical axis of the outgoing light ray of the second optical shifting section is defined by one of first, second, third and fourth positions according to a combination of voltages to be applied to the liquid crystal elements of the first and second optical shifting sections, the first position being aligned with the optical axis of the incoming light ray of the first optical shifting section, the second position having been shifted by Δd from the optical axis of the incoming light ray of the first optical shifting section, the third position having been shifted by $2\Delta d$ from the optical axis of the incoming light ray of the first optical shifting section, the fourth position

having been shifted by $3 \Delta d$ from the optical axis of the incoming light ray of the first optical shifting section.

10. The optical shifter of claim 5, wherein the optical axis of the outgoing light ray of the second optical shifting section is defined by one of first, second, third and fourth positions according to a combination of voltages to be applied to the liquid crystal elements of the first and second optical shifting sections, the first position being aligned with the optical axis of the incoming light ray of the first optical shifting section, the second position having been shifted by Δd from the optical axis of the incoming light ray of the first optical shifting section, the third position having been shifted by $2 \Delta d$ from the optical axis of the incoming light ray of the first optical shifting section, the fourth position having been shifted by $3 \Delta d$ from the optical axis of the incoming light ray of the first optical shifting section.

11. The optical shifter of claim 6, wherein the liquid crystal cell is a TN mode liquid crystal cell exhibiting positive dielectric anisotropy $\Delta \epsilon$ and the birefringent element is a quartz plate of uniaxial crystals.

12. The optical shifter of claim 9, wherein the liquid crystal cell is a TN mode liquid crystal cell exhibiting

positive dielectric anisotropy $\Delta \epsilon$ and wherein the birefringent element is a quartz plate of uniaxial crystals.

13. The optical shifter of claim 7, wherein the first and second liquid crystal cells are TN mode liquid crystal cells, exhibiting positive dielectric anisotropy $\Delta \epsilon$ and having opposite optical rotatory directions, and are arranged such that directors cross each other at right angles on a pair of planes of the first and second liquid crystal cells that are opposed to each other, and wherein the birefringent element is a quartz plate of uniaxial crystals.

14. The optical shifter of claim 8, wherein the first and second liquid crystal cells are TN mode liquid crystal cells, exhibiting positive dielectric anisotropy $\Delta \epsilon$ and having opposite optical rotatory directions, and are arranged such that directors cross each other at right angles on a pair of planes of the first and second liquid crystal cells that are opposed to each other, and wherein the birefringent element is a quartz plate of uniaxial crystals.

15. The optical shifter of claim 10, wherein the first and second liquid crystal cells are TN mode liquid crystal cells, exhibiting positive dielectric anisotropy $\Delta \epsilon$ and having opposite optical rotatory directions, and are arranged

such that directors cross each other at right angles on a pair of planes of the first and second liquid crystal cells that are opposed to each other, and wherein the birefringent element is a quartz plate of uniaxial crystals.

16. A method for driving the optical shifter of claim 11, wherein the optical axis of the outgoing light ray of the second optical shifting section repeatedly shifts from one of the first, second and third positions to the next in this order, and

wherein the method comprises the step of regulating the voltages to be applied to the liquid crystal cells of the first and second optical shifting sections such that the voltages being applied to the liquid crystal cells of the first and second optical shifting sections are not suspended simultaneously whenever the optical axis of the light ray shifts from one of the three positions to the next.

17. A method for driving the optical shifter of claim 11, wherein the optical axis of the outgoing light ray of the second optical shifting section repeatedly shifts in the order of the first, second, third, first, third and second positions, and

wherein the method comprises the step of regulating the voltages to be applied to the liquid crystal cells of the

first and second optical shifting sections such that the voltages being applied to the liquid crystal cells of the first and second optical shifting sections are suspended simultaneously the smallest number of times when the optical axis of the light ray shifts from one of the three positions to the next.

18. A method for driving the optical shifter of claim 12, wherein the optical axis of the outgoing light ray of the second optical shifting section repeatedly shifts from one of the first, second, third and fourth positions to the next in this order, and

wherein the method comprises the step of regulating the voltages to be applied to the liquid crystal cells of the first and second optical shifting sections such that the voltages being applied to the liquid crystal cells of the first and second optical shifting sections are not suspended simultaneously whenever the optical axis of the light ray shifts from one of the four positions to the next.

19. A method for driving the optical shifter of claim 13, wherein the optical axis of the outgoing light ray of the second optical shifting section repeatedly shifts from one of the first, second and third positions to the next in this order, and

wherein the method comprises the step of regulating the voltages to be applied to the first and second liquid crystal cells of the first and second optical shifting sections such that a period of time in which no voltages are applied to the first or second liquid crystal cells of the first and second optical shifting sections is longer than a period of time in which one of the three positions is being selected.

20. A method for driving the optical shifter of claim 15, wherein the optical axis of the outgoing light ray of the second optical shifting section repeatedly shifts from one of the first, second and third positions to the next in this order, and

wherein the method comprises the step of regulating the voltages to be applied to the first and second liquid crystal cells of the first and second optical shifting sections such that a period of time in which no voltages are applied to the first or second liquid crystal cells of the first and second optical shifting sections is longer than a period of time in which one of the three positions is being selected.

21. A projection type optical display system comprising:

a light source;

a display panel including multiple pixel regions, each

of which is able to modulate light;

a light control system for splitting the light, which has been emitted from the light source, into light rays falling within a number of wavelength ranges and focusing the split light rays onto associated ones of the pixel regions according to the wavelength ranges thereof;

an optical system for forming an image on a projection plane by utilizing the light that has been modulated by the display panel;

a circuit for generating data representing multiple image subframes from data representing each image frame as a component of the image and getting the image subframes displayed by the display panel time-sequentially; and

the optical shifter of claim 1 for shifting, on the projection plane, a selected one of the multiple image subframes being displayed by the display panel.

22. A projection type optical display system comprising:

a light source;

a display panel including multiple pixel regions, each of which is able to modulate light;

a light control system for splitting the light, which has been emitted from the light source, into light rays falling within a number of wavelength ranges and focusing the

split light rays onto associated ones of the pixel regions according to the wavelength ranges thereof;

an optical system for forming an image on a projection plane by utilizing the light that has been modulated by the display panel;

a circuit for generating data representing multiple image subframes from data representing each image frame as a component of the image and getting the image subframes displayed by the display panel time-sequentially; and

the optical shifter of claim 3 for shifting, on the projection plane, a selected one of the multiple image subframes being displayed by the display panel.

23. A projection type optical display system comprising:

a light source;

a display panel including multiple pixel regions, each of which is able to modulate light;

a light control system for splitting the light, which has been emitted from the light source, into light rays falling within a number of wavelength ranges and focusing the split light rays onto associated ones of the pixel regions according to the wavelength ranges thereof;

an optical system for forming an image on a projection plane by utilizing the light that has been modulated by the

display panel;

a circuit for generating data representing multiple image subframes from data representing each image frame as a component of the image and getting the image subframes displayed by the display panel time-sequentially; and

the optical shifter of claim 4 for shifting, on the projection plane, a selected one of the multiple image subframes being displayed by the display panel.